

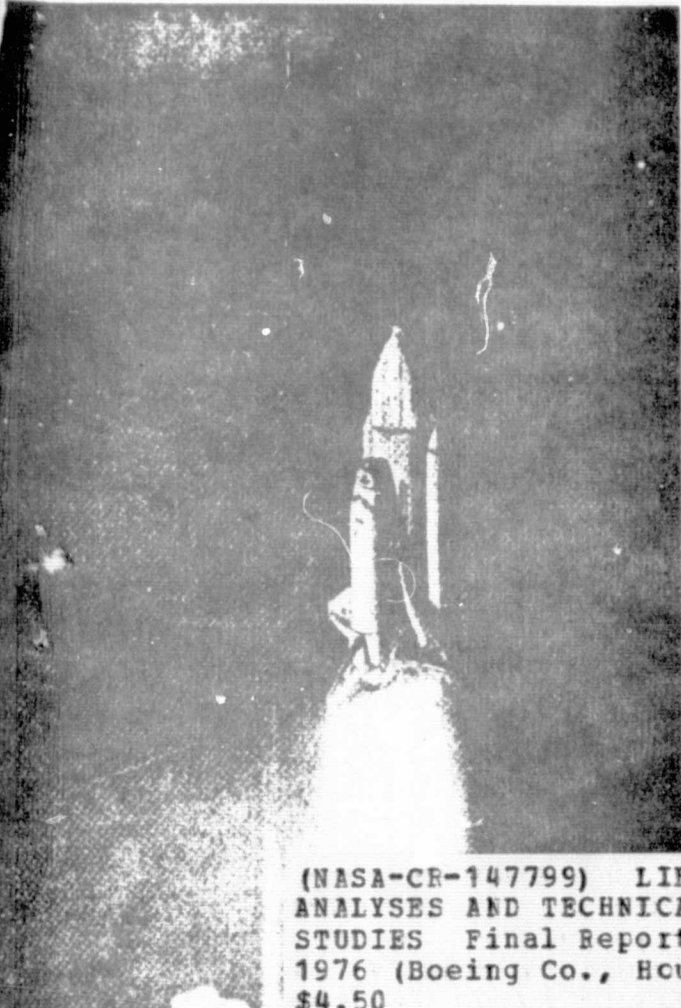
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FINAL REPORT

NASA CR-
147799



(NASA-CR-147799) LIFE SCIENCES PAYLOADS
ANALYSES AND TECHNICAL PROGRAM PLANNING
STUDIES Final Report, 1 Jul. 1973 - 30 Apr.
1976 (Boeing Co., Houston, Tex.) 55 p HC
\$4.50

N76-27812

Unclas
CSCI 22A G3/51 44552

LIFE SCIENCES PAYLOADS ANALYSES AND TECHNICAL PROGRAM PLANNING STUDIES

CONTRACT NAS 9-13655



THE **BOEING** COMPANY
HOUSTON, TEXAS 77058
APRIL 1976

LIFE SCIENCES PAYLOADS ANALYSES AND TECHNICAL PROGRAM PLANNING STUDIES
CONTRACT NAS 9-13655

FINAL REPORT

Submitted to:

BIOSCIENCE PAYLOADS OFFICE
LIFE SCIENCES DIRECTORATE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS 77058

APRIL 1976

LIFE SCIENCES PAYLOADS ANALYSES AND TECHNICAL PROGRAM PLANNING STUDIES

CONTRACT NAS 9-13655

FINAL REPORT

Report Period: July 1, 1973, through April 30, 1976

Materials under this contract and this Final Report were prepared by members of the Boeing Life Sciences Payloads Team.

Approved by



William B. Lewis
Manager, Boeing Life Sciences

Approved by



William H. Bush, Jr.
NASA Technical Monitor

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ABBREVIATIONS AND ACRONYMS

ARC	Ames Research Center
CVT	Concept Verification Testing
GD/C	General Dynamics/Convair
GIL	Gravity Independent Laboratory
IMBLMS	Integrated Medical and Behavioral Laboratory Measurement System
JSC	Johnson Space Center
LSP	Life Sciences Payloads
LSPDF	Life Sciences Payloads Development Facility
MOT	Mission Operations Team
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
POCC	Payload Operations Control Center
SMS-I	Spacelab Mission Simulation - Test I
SMS-II	Spacelab Mission Simulation - Test II
STARPAHC	Space Technology Applied to Rural Papago Advanced Health Care

SUMMARY

The activities reported herein are in accordance with NASA Contract NAS 9-13655 and include the tasks accomplished under the basic contract (Exhibit A) and contract additions (Exhibits B through H).

The tasks associated with this contract were unique and of particular value in that they involved participation in the initial stages of the Johnson Space Center (JSC) Life Sciences Shuttle Payloads Program definition and development. These efforts provided the Bioscience Payloads Office with scientific and technical information useful in directing the development of JSC Shuttle payloads concepts. In addition, the materials developed during this period were useful in planning and implementing Life Sciences Spacelab Mission Simulations I and II, which were conducted in October 1974 and January 1976, respectively.

This Final Report consists of a summary of accomplishments and an overview of the entire effort associated with Contract Exhibits A through H. The material has been organized by results pertinent to the Life Sciences Payload Concepts Development Program, Life Sciences Payloads Project Office Program Support, Life Sciences Program Planning, the IMBLMS (Integrated Medical and Behavioral Laboratory Measurement System) Equipment Survey, Space Processing Colloquium information, and Life Sciences Spacelab Mission Simulations.

The analyses and studies conducted in support of this contract indicate that early definition of the Shuttle payloads concepts, through testing such as the planned Spacelab Mission Simulations, will greatly enhance the definition and development of a JSC Life Sciences Payloads Development Facility (LSPDF) and of Life Sciences Shuttle Payloads.

SUMMARY - (concluded)

Task products of the most significant efforts accomplished under this contract are included as examples of the scope of effort involved. (Attachments II and III)

1.0 INTRODUCTION

This report covers Boeing accomplishments under Life Sciences Contract NAS 9-13655, Payloads Analyses and Technical Program Planning Studies, during the period of July 1, 1973, through April 30, 1976. Boeing efforts were mainly directed toward the following areas:

- ° Life Sciences Payloads Program Planning
- ° Life Sciences Payloads Development Facility Requirements Definition
- ° Life Sciences Spacelab Mission Simulations Planning
- ° Space Processing for Biochemical or Biomedical Materials Symposia
- ° Addition of IMBLMS Data to the Life Sciences Payloads Definition and Integration Study Bank
- ° Preparation of Spacelab Mission Simulation Documentation

Verbal and written reports, studies, and analyses presented to the Bioscience Payloads Office documented the results of these efforts as they were accomplished. (Attachment III)

1.1 OBJECTIVES

1.1.1 Exhibit A, Statement of Work dated 7/1/73, Life Sciences Payloads Analyses and Technical Program Planning Studies

The main objective of this contract task was to provide information and to develop technical data for use by the Bioscience Payloads Office in the definition and management of the JSC Life Sciences Shuttle Payload Concepts Development effort. In support of this effort, Boeing was to define a series of Shuttle Payloads Program major goals and document an approach to the Shuttle Payloads Flight Program. In addition, the significant activities of this Preparation Phase associated with the Shuttle payloads flights were to be defined.

1.1.1 (continued)

Under this concept, the early Preparation Phase (the initial three-year period) would be devoted to completing program definition and concept development to support the flight program. In support of program development and for use later during the flight period, two types of facilities would be required. One of these facilities would be devoted to concept development and would be designated the LSPDF. The other facility would be dedicated to payloads flight support and would be called the Payload Operations Control Center (POCC). The original Boeing contract included the development of requirements and the formulation of preliminary concepts for these facilities (the Gravity Independent Laboratory which was later modified to the facility concepts defined herein, i.e., the LSPDF).

The development of facilities was to be accomplished in a phased manner involving three classes of facility configuration. Class I facility configuration would use a combination of functional installations and non-functional mockups of experiment equipment and laboratory consoles. This class of facility was used for the first Life Sciences Spacelab Mission Simulation (SMS-I) in October 1974. Additional development and improvements were accomplished to achieve the Class II facility which featured improved functional equipment and upgraded mockup fidelity such as the use of accurate wooden mockups of the Spacelab and portions of the Orbiter which are associated with payloads activities. The second JSC Life Sciences Spacelab Mission Simulation (SMS-II) was accomplished in a Class II facility in January 1976.

Class III facility configurations would feature high fidelity hard mockups of the Spacelab experiment and support sections, in addition to an improved

1.1.1 (continued)

Orbiter lower deck and Payloads and Mission Specialist Stations. The Class III payloads facility would have full capability in consoles and equipment to support life sciences payloads activities, including experiment integration, testing operations, crew training, and mission simulations.

To verify the design and operational concepts of the JSC life sciences payloads and facilities, a series of Spacelab simulations were to be defined. Over a five-year period these tests would serve as drivers in the development of LSP experiments, equipment, and supporting facilities. They addressed the seven disciplines associated with life sciences, i.e., Biomedical, Vertebrates, Plants, Cells and Tissues, Invertebrates, Life Support and Protective Systems, and Man/System Integration.

1.1.2 Exhibits B and D, Statements of Work dated 1/15/74 and 12/23/74, respectively, Space Processing for Biochemical or Biomedical Materials

The major objectives associated with Exhibits B and D concerning space processing for biochemical or biomedical materials, were the preparation of plans and the definition of requirements for a series of symposia on this subject. Exhibit D was an extension and expansion of efforts defined in Exhibit B. Boeing was to prepare detailed plans for a meeting of 50 to 60 scientists to be held in the fall of 1974; such plans to include the major pieces of correspondence and planning paper required to assure a well organized meeting. NASA would retain the responsibility for the identification and selection of attendees and the scheduling of the meeting.

1.1.3 Exhibit C, Statement of Work dated 1/15/74, IMBLMS Equipment Survey

Two types of effort were required on the Exhibit C task concerning simulator function requirements and engineering data on IMBLMS equipment. The objective of the simulator function requirements task was to develop concepts applicable to life sciences payloads, to be included in the Preliminary Facility Specification produced in support of the LSPDF.

An engineering study and analysis was to be performed on IMBLMS Phase B-4 documents with the objective of extracting equipment information and data to be added to the Life Sciences Program Definition and Integration Study Data Bank. The equipment was to be identified and categorized by functions and listings in accordance with the existing data bank format.

1.1.4 Exhibits E and G, Statements of Work dated 12/23/74 and 5/19/75, respectively, Research and Development in Preparation for and in Support of NASA's Life Sciences Payloads Program Activities

A program analysis and study was to be performed with the objective of defining the engineering, scientific, and management requirements for a Life Sciences Mission Simulation Program. Exhibit G was an extension and expansion of efforts defined in Exhibit E. Preliminary requirements were to be developed for a series of five or more Spacelab Mission Simulations involving dedicated life sciences payloads as well as shared and carry-on payloads.

This program plan was to provide preliminary definition of the program structure, program/mission objectives and emphasis, mission descriptions, principal areas of development, management systems, experiment/payloads processing, mission operations, equipment and facilities, and the roles and relationships of organizations and key personnel.

1.1.4 (continued)

Another objective of the simulation planning was the definition of a documentation system which would be less complex than those associated with previous space programs. The system developed was to provide a simple means of incorporating changes based on experience gained during the Spacelab simulations.

1.1.5 Exhibit F, Statement of Work dated 1/1/75, Evaluation of the Shuttle Orbiter Urine Management System

A major objective of this effort was to insure that hardware designed and assembled in support of the Shuttle Orbiter Urine Management System would meet the performance and operational requirements established by the NASA Life Sciences Directorate. The task was to be accomplished by the continuous review and evaluation of the design, development, and testing of systems specifically for urine collection and processing. In addition, where specific requirements did not exist, such requirements would be established based on mission profiles, timelines, and experiment objectives.

The design and development of water management systems for Shuttle missions required the incorporation and integration of Shuttle Orbiter Urine Management System interface connections and operational characteristics. An objective of this task was to determine or define such specific requirements.

1.1.6 Exhibit H, Statement of Work dated 7/10/75, Documentation

Timely reporting of the simulated missions in a family of comprehensive reports was a major objective of this effort. The contractor was to coordinate the compilation of report materials, edit, type, and format these inputs into a series of reports to be released by NASA. Upon completion of the preparation

1.1.6 (continued)

of the document materials, Boeing was to coordinate the reproduction through the NASA reproduction/printing facilities.

1.2 SCHEDULE

The priority, sequence, and schedule of tasks associated with Exhibits A through H were developed in coordination with the Bioscience Payloads Office.

The schedule of task effort and completion dates is presented in Figure 1.

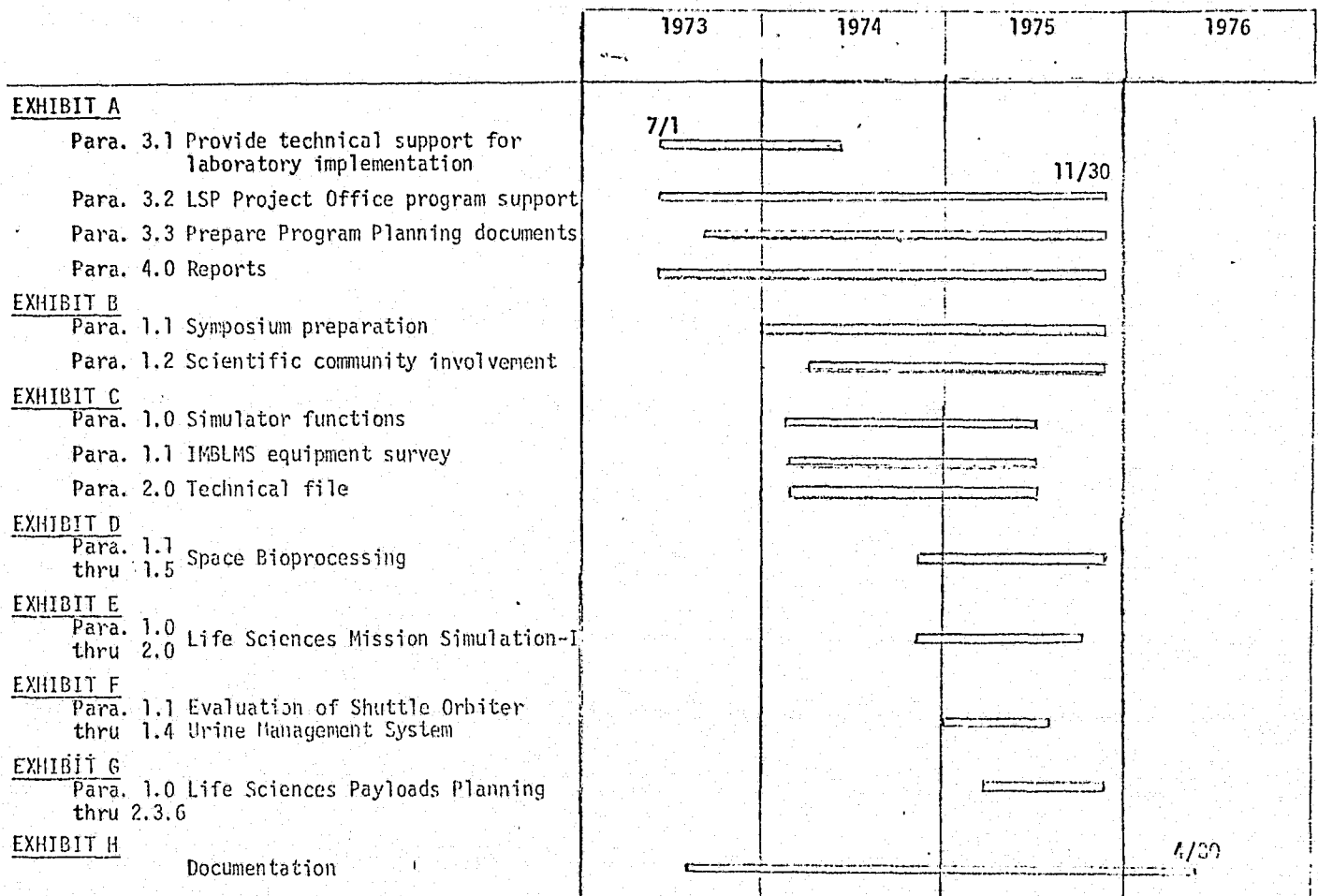


Figure 1. Task Schedule - Contract NAS 9-13655

1.3 REPORTS

During the contract period, Boeing provided study and analyses reports, in the form of engineering and scientific memoranda, and Monthly Progress Reports to the Bioscience Payloads Office. Boeing transferred technical information to NASA by means of 2-Way Memos (Form No. 5027-102 Optional Form 27) with attachments. This method provided a convenient correspondence control and tracking/retrieval capability. Attachment II is a listing of 2-Way Memos transmitted to NASA during the contract period of performance.

Upon completion of a specific effort, the research materials gathered to support these contract tasks were placed in the Payloads Office Technical File.

Attachment II is a listing of the more significant reports resulting from these contract tasks.

2.0 SUMMARY OF ACCOMPLISHMENTS

The following sections will briefly summarize the results of the tasks associated with this contract.

2.1 EXHIBIT A - LIFE SCIENCES PAYLOADS ANALYSES AND TECHNICAL PROGRAM PLANNING STUDIES

2.1.1 Paragraph 3.1 - Provide Engineering and Technical Support for Laboratory Definition and Implementation

Thirteen studies and analyses were performed and reported upon concerning preliminary concept definition and development of the JSC Life Sciences Payload Concepts Development Program. These studies included concept definition, preliminary facility requirements definition, facility layouts, and illustrations of the proposed LSPDF. In addition, a Life Sciences Payloads Test Program was defined. Considerable Boeing effort was expended in gathering information and in performing the studies and analyses associated with the definition of Life Sciences Payloads Development Program Test I, scheduled and performed in October 1974.

2.1.2 Paragraph 3.2 - Life Sciences Payloads Project Office Program Support

The life sciences payloads support rendered to the Bioscience Payloads Office by Boeing consisted mainly of special studies, analyses, and documentation reviews. Many engineering studies and scientific analyses were accomplished in the performance of this task. Attachment II is a listing of the more significant studies and analyses associated with life sciences payloads. A significant portion of this contract effort involved the review of Shuttle payloads documents. A listing of eight of the more significant document reviews is also included in Attachment II (item 3, D).

2.1.3 Paragraph 3.3 - Life Sciences Program Planning

Boeing performed a number of special program planning activities associated with the definition and preliminary planning of the JSC Life Sciences Shuttle Payloads Program. During this period, a large part of the effort included engineering, scientific, and managerial participation on the Mission Operations Team (MOT). The MOT, composed of NASA and contractor personnel, was set up by the Bioscience Payloads Office to function as a working group to identify, process, and review scientific demonstration candidates for Test I. To insure the technical validity of Test I and to realize maximum benefit from this effort, the definition of a preliminary JSC Life Sciences Shuttle Payloads Program was required. In support of the Bioscience Payloads Office, Boeing developed a Preliminary Program Plan which calls for the parallel development of payloads concepts as well as the facilities to support and test these concepts. Under the direction of the Bioscience Payloads Office, Boeing prepared the document which defines the objectives and scope and provides the details on a series of activities associated with Test I, i.e., Spacelab Life Sciences Mission Simulation, Payload Test I Program Plan and Requirements.

2.2 EXHIBITS B AND D - SPACE PROCESSING FOR BIOCHEMICAL OR BIOMEDICAL MATERIALS SYMPOSIA

2.2.1 Paragraph 1.1 - Symposium Preparation

All major design decisions have been determined for the Shuttle, and the same was true for the Spacelab after its Preliminary Requirements Review was held in 1975. Beyond this event, the design features of both vehicles remained fairly constant and the payloads equipment and processes are designed to operate within the fixed system design constraints.

2.2.1 (continued)

To begin this process specifically for the space processing of biochemical or biomedical materials, it was necessary to define requirements. A workshop, originally scheduled by NASA for November or December of 1974, was expected to be the first step in establishing these requirements which would, in turn, indicate the necessary equipment to be developed or modified.

The plans were made and preparations were being coordinated for a symposium. A schedule of events and activities plus preliminary copies of correspondence and tracking data were transmitted to NASA via 2-Way Memo. These plans were then revised and updated to support the revisions requested by the Technical Monitor.

2.2.1.1 Review Status of Current Programs

The status of current programs relating to space manufacturing and inflight analysis were reviewed and are summarized as follows:

There were 66 active projects in space processing which were included in NASA's "Supporting Research and Technology (SRT) Program", data presented at the "Third Space Processing Symposium - Skylab Results". Most of these projects were of the size appropriate to provide for effort by a single full-time scientist assisted by the usual supporting services. Of this total, 50 were being performed in-house or through contracts by Marshall Space Flight Center (MSFC), and the rest were distributed among Jet Propulsion Laboratories - 5 projects; National Bureau of Standards - 5 projects; Langley Research Center - 3 projects; Johnson Space Center - 2 projects; and Ames Research Center (ARC) - 1 project.

2.2.1.1 (continued)

Most of these projects on space processing concerned metallurgical properties and crystal growth. The only biological application of space processing that was being systematically investigated was electrophoretic separation and purification of biological materials. This work, under the auspices of MSFC, was concentrated on preparation of pure fractions of human cells. The preparation methods under development included zone electrophoresis in static and flowing liquid media, and isotachophoresis in static media.

There was one current active project in chemistry, namely, a small-scale study at ARC of the feasibility of using weightlessness to increase the structural regularity of long-chain molecules produced by catalytic polymerization.

The "Third Space Processing Symposium - Skylab Results" was attended on April 30 and May 1, 1974. A trip report was submitted with a 2-Way Memo on May 8, 1974.

2.2.1.2 Investigate Problem Areas Induced by Zero-g

The results from tests and experiences from Apollo and Skylab as well as ballistic trajectory aircraft flights were researched. These programs provided many vivid illustrations of how the behavior of liquids and gases differs under zero-g conditions. For example, it was found that unrestrained liquid masses, which could result from accidental spills, would form large free-flying globules; that vapor bubbles could grow virtually without limit in boiling liquids; and that flames quickly became blanketed with their own combustion products.

2.2.1.3 Identify Guidelines

The guidelines for selecting and prioritizing techniques and procedures should be based on the following considerations to obtain maximum benefits with minimal impact on available special resources and talents planned for Shuttle flights.

A. Equipment requirements to be considered:

1. Conservation of space-dedicated space in Spacelab will be critical.
2. Normal electrical power consumption - electrical power will be supplied from Shuttle power supplies. Additional power can be supplied at a weight penalty of the additional H₂ and O₂ required for fuel.
3. Weight considerations - since the Shuttle has a critical weight problem, additional weight could shorten the length of missions. Additional weight would require more ballast to maintain the center of gravity within acceptable limits.

B. Safety considerations - Crew safety must be given highest priority. Equipment safety, while not requiring the reliability factors of the Apollo mission equipment, is still a big consideration requiring much ground testing and analysis prior to flight.

C. Contamination - Techniques and procedures must be chosen and tested to prevent contamination from other experiments or sources and to prevent accidents that could endanger or contaminate other experiments or processes. Fluids, once spilled into the zero-g atmosphere of space, are difficult to recover.

2.2.1.3 (continued)

- D. Logistics requirements - The logistics required of the techniques and procedures for the experiments and/or processes will be major considerations because of costs, storage space, and handling requirements.
- E. Special talent available - Special talent on board the Shuttle flights is expected to be limited to conserve consumables, therefore, the procedures and techniques must be chosen with simplicity of operation as a consideration.

2.2.2 Paragraph 1.2 - Scientific Community Involvement

A plan was presented to NASA for accomplishing numerous contacts with a group of scientists. A series of telephone calls was made to assess the interest of the scientific community in bioprocessing in space. Approximately 100 contacts were made with scientists in professional societies, universities, and pharmaceutical firms. These contacts provided the initial listing of attendees for a colloquium.

The mailing addresses of all the medical schools that might be interested in the program and the names of the deans were collected and filed. A flyer was prepared with a preliminary program to be sent to each dean notifying him of the forthcoming workshop and inviting the attendance of interested scientists at his school.

A brochure was prepared and given to NASA for printing. The brochure described past space accomplishments in bioprocessing and future planning for space exploration. This brochure was to be given wide distribution to further

2.2.2 (continued)

involve the scientific community in bioprocessing in space.

The basic planning was performed for a colloquium to be held at JSC in the spring of 1976. A preliminary Colloquium Plan was prepared which contained the planning and methodology necessary to ensure a successful meeting.

2.3 EXHIBIT C - ADDITION OF IMBLMS DATA TO THE LIFE SCIENCES PAYLOADS DEFINITION AND INTEGRATION STUDY DATA BANK

2.3.1 Summary of Task Accomplishments

An analysis of the IMBLMS Phase B-4 Equipment List and the General Dynamics/Convair (GD/C) Data Bank was undertaken to determine the methods and equipment selections to be used in adding the IMBLMS protocols and associated equipment to the GD/C Data Bank. The GD/C format is divided as follows:

- A. Functions and Methods Listing - procedural data on types of experimental measurements (protocols or procedures) included in the Data Bank.
- B. Equipment Listing - A cross-reference of the equipment (instrumentation) needed to accomplish the functions and methods listed in A above.

IMBLMS documentation for all phases up to the current STARPAHC (Space Technology Applied to Rural Papago Advanced Health Care) effort was reviewed to determine applicability to this task. The Phase B-4 reports by the Lockheed Missiles and Space Co., Inc. and the General Electric Company were selected as data sources, since these reports contained procedures and equipment which

2.3.1 (continued)

would best supplement the GD/C listing. The necessary measurement information and the associated equipment listings were extracted, arranged in the proper format, and submitted to the Contract Technical Monitor. All phases of this task were completed except for establishing IMBLMS equipment costs (this data was not included in the reports). A substantial effort was made by Boeing in coordination with the IMBLMS Program Office and the IMBLMS Contract Officer to obtain this data, but no individual costs were available on these equipment items, therefore, the data could not be added to this report.

During the development of SMS-I requirements, a management decision was made to exclude the simulation function from the actual test. During SMS-II, a simulation console was incorporated wherein simulated failures could be introduced into the system. These simulated anomalies provided opportunities for the Test Team and crew to address hardware system problems similar to those that could be experienced during an actual mission.

2.4 EXHIBITS E AND G - RESEARCH AND DEVELOPMENT IN PREPARATION FOR AND IN SUPPORT OF NASA'S LIFE SCIENCES PAYLOADS PROGRAM ACTIVITIES

In accordance with the Statement of Work, Boeing provided requirements definitions for the first life sciences flight mission experiments payload and assisted in the summarization of SMS-I results. Boeing performed studies and provided technical, scientific, and planning information to support the implementation of SMS-II facilities, experiments, and operational tests.

Under a working agreement between the Bioscience Payloads Office and the Bio-engineering Systems Division, Boeing supported schedule development for SMS-II

2.4 (continued)

and assisted in defining a payloads facilities preparation and implementation plan.

Recommendations were provided to NASA for specific modifications to update the LSPDF to a Class II configuration. Boeing supported the initial test planning and development of requirements for the experiments and operational tests to be conducted during SMS-II.

2.5 EXHIBIT F - TESTING AND EVALUATION OF SHUTTLE ORBITER URINE MANAGEMENT SYSTEM

In support of preliminary design for the Shuttle Orbiter Urine Management System, a comprehensive review was conducted of all biowaste sampling techniques used in previous U. S. manned space flights. Basic system approaches used in Soviet missions were also evaluated. At the conclusion of this review, recommendations were provided regarding design and performance for the waste management collection system.

Following selection of the prime contractor for the Shuttle Orbiter Urine Management System, liaison was established with the contractor so that NASA Life Sciences requirements or changes in requirements could be incorporated in design and fabrication of this waste management system. Inputs such as mounting dimensions, available power, collection frequency, and sample preservation requirements were provided to the contractor. Test protocols proposed by the equipment manufacturer for verification of the system were reviewed and evaluated by Boeing.

Due to the requirement for a supply of water to the Shuttle Orbiter Urine Management System, a feasibility study was conducted on the use, in line, of a disinfectant-coated ion exchange resin cartridge to act as a safety check valve and to prevent back contamination of the water supply system. Results of the evaluation indicated such a device could be used between the water and waste systems.

Protocols were prepared for test and evaluation of the urine system components during planned Shuttle mission simulations at NASA Centers. In addition to test protocols, crew operating and maintenance procedures were prepared. An implementation plan for the Waste Management Vacuum System was prepared and coordinated with appropriate organizations. Data handling protocols for urine volume data were prepared and coordinated.

2.6 EXHIBIT H - DOCUMENTATION

The following chronological listing identifies all preparation, editing, and completion dates of documents produced during this contract period.

1973

7/17 Skylab 1/2 Interim R+21 Day Medical Report, JSC-08076.
7/23 Mission Evaluation Medical Report, Skylab 1/2.
9/26 Skylab 1/2 Preliminary Biomedical Report, JSC-08439.
10/18 Mission Evaluation Medical Report, Skylab 3.
11/8 Skylab 3 Interim 59-day Biomedical Report, JSC-08504.

1974

3/6 Skylab 4 Mission Evaluation Report.
3/22 Skylab 3 Preliminary Biomedical Report, JSC-08668.
3/27 Skylab 4 Interim Biomedical Report, JSC-08818. (recalled)
7/2 Corrections and Additions to Skylab 1/2 Biomedical Report.
10/22 Skylab Life Sciences Symposium Proceedings, Russian gift issue.
11/11 The Proceedings of the Life Sciences Skylab Biomedical Report,
TM-X58154.

2.6 (continued)

1975

1/15 Shuttle Test 1.
2/4 Biomedical Report of Skylab (hard back volume for WDC started) SP 377.
2/10 Skylab 4, Preliminary Biomedical Report, JSC-08818. (number reassigned)
4/15 Spacelab Mission Simulation, Life Sciences Payload Test I, General Summary. Sections 1, 2, 3, 4, and 5.
5/9-7/30 Various sections of SP 377 to Washington, D.C. (Rex Matthews).
7/24 Bioprocessing in Space - brochure.
8/6 Shuttle SMS-II, Development Plan, DE-SMS-II-017, (Attachment V).
8/26 Shuttle SMS-I, General Summary Report.
9/22 Edited 41 pieces of line art for SP 377 and returned to WDC.
9/22 Shuttle SMS-II Experiments and Operations Requirements document.
10/3 SMS Life Sciences Payloads Reporting Plan - "preliminary".
10/21 Edited 26 pieces of line art for SP 377.
10/31 Edited 26 pieces of line art for SP 377.
11/8 SMS-II Experiments and Operations Requirements - "final version", DE-SMS-II-018, (Attachment V)
12/5 Edited figure 19-14 and appendix C for SP 377.
12/8 DA-SMS-001, SMS Program Plan.
12/11 Cosmic Ray Laboratory Experiment for SMS-II (revision and amplification).

1976

1/29 Edited 52 pieces of line art for SP 377.
2/4 Edited line art for chapters 29 and 30 of SP 377.
2/5 Edited 59 pieces of line art for SP 377.
2/16 Edited 115 line drawings for SP 377.
2/18 Edited 3 line drawings for SP 377.
2/20 Corrections and additions to sec. 4.12, 5.8(A), 5.9A, and 5.15 Experiments and Operations Requirements document, DE-SMS-II-018.
3/24 ASTP Life Sciences Biomedical Report, JSC 10985, TR-? (not assigned as yet).
4/5 Schedule for SMS-II Reports initiated.
4/9 Complete copy editing of Life Sciences Biomedical Results of Skylab, SP 377 finished.
4/12 LRL (Lunar Rover Lab) Story completed. Copy to R. Bryan Erb for his additions.

ATTACHMENT I

STATEMENTS OF WORK

EXHIBIT A
STATEMENT OF WORK
LIFE SCIENCES PAYLOADS ANALYSES
AND TECHNICAL PROGRAM PLANNING STUDIES

1.0 INTRODUCTION

NASA is pursuing a program to develop Life Science Payloads (LSP) for the Space Shuttle Program. Such payloads will enhance utilization of early space station complexes and the subsequent space, lunar, and inter-planetary craft that progressively evolve. Initial LSP will emphasize "0" gravity biomedical and biological experiments. These early payloads will form the basis for developing inflight diagnostic, therapeutic, and remedial medical procedures. In addition, strategies will be developed for space biology research, long-term life support and space fabrication capabilities for future space missions.

The LSP program is presently in the definition phase. Current planning provides for implementing and utilizing a functional sortie laboratory mockup (M/U) to support the definition of equipment requirements, experiment protocols, and laboratory operational concepts and requirements. The NASA/JSC plans to implement a Gravity Independent Laboratory (GIL) as a mockup and is extensively involved in the formulation of overall LSP program planning. This planning effort will result in documented approaches to be used in soliciting and selection of experiments and the involvement of the Life Sciences scientific community, the incorporation of experiments into logically organized payloads, and defining the laboratory equipment and layout requirements to effectively accommodate the various payloads. This planning and the approaches developed will draw heavily on the experience and knowledge acquired in all previous life science programs and study efforts such as the Apollo, the Skylab, and IMBLMS programs and the General Dynamics/Convair Life Sciences Definition and Integration Study.

The accomplishment of M/U implementation and utilization and the early development of comprehensive program planning requires the extraction of maximum program value from the IMBLMS program and closely related Skylab medical experiments. Studies and analyses of information from these programs relating to equipment selection, measurement requirements, data management systems, experiment protocol standardization, and laboratory operations requirements are required to support the definition of equipment functions, designs, procedures, and techniques to be used in the LSP program.

In addition, planning studies and analyses must be conducted to support the development of organizational and approach concepts for implementing an effective overall LAP program. The results of this effort must be appropriately documented to provide for program management and control.

Supporting materials for accomplishing the early phases of LSP program implementation such as charts, brochures, manuals, design sketches, etc., must be prepared in sample form suitable for submission for art work and reproduction.

2.0 General Requirements

The contractor shall conduct research and development tasks delineated in Section 3.0 titled "Specific Requirements", in preparation for and in support of NASA's accomplishment of the LSP program activities. Included are: (1) tasks pertinent to the implementation and operation of the LSP sortie laboratory M/U (or Gravity Independent Laboratory [GIL]), (2) tasks related to the development of LSP program concepts and approaches, and (3) tasks related to the formulation of LSP program implementation materials and documents. The nature of the tasks will require immediate access to NASA materials and reference files and extensive coordination with NASA/JSC personnel. Accordingly, it is necessary that portions of the effort described in the Statement of Work be performed at the NASA/JSC facility.

3.0 Specific Requirements

The contractor shall accomplish the following tasks:

3.1 In conjunction with the implementation and operation of the Gravity Independent Laboratory (GIL) the contractor shall provide technical support to accomplish the following tasks:

3.1.1 Prepare layouts and sketches of proposed mockup (GIL) equipment configurations to provide an organized and efficient experimental area. These layouts will be used in defining the optimum physical configuration and experiment layout. Mechanical and electrical interface requirements will be defined, planned, and integrated into the GIL.

3.1.2 Prepare equipment for installation in the mockup to insure that all operational simulations are functional and proposed protocols can be satisfactorily accomplished in the proposed layout, therefore assuring satisfactory equipment integration.

3.1.3 Provide engineering and technical support of the equipment installation, checkout, and operations to insure mechanical and electrical system integrity and to enhance the mockup utilization.

NOTE: When operational equipment of a specific type is not available to the mockup, non-functional components will be integrated into the design to insure that interface requirements and provisions are met to facilitate later installation of operational equipment with minimal impact on mockup operations and scheduling.

3.1.4 Perform studies to support definition of the operational requirements of the GIL in conformance with the program goals and methods and to support planning which will assure that all objectives are met.

- 3.1.5 Provide engineering and technical support/participation in the conduct of mockup experiments, studies, and operations. This support will involve definition of requirements for operations, maintenance, and planning activities such as system operations, equipment set-up, calibrations, troubleshooting, minor repairs, and logistics activities including materials ordering, storing, controlling, and dispensing of equipment, parts, and expendables. Planning and scheduling of specialized services, such as radiological support, computer maintenance, or special equipment calibrations will be included.
- 3.1.6 Coordinate with NASA potential principal investigators and provide information to assist in the operation of mockup associated equipment in the conduct of life sciences experiments and demonstrations.
- 3.1.7 Conduct the studies to define the Man/System Integration requirements including human engineering aspects of man/system interfaces on the GIL equipment and facilities. Design sketches will be prepared for the anticipated or planned experimental protocols to assure adequate subject/operator safety and optimum mockup equipment utilization. Payload concept, experimental protocol, schedule, and staffing will be considered in the definition of an optimized plan for mockup utilization.
- 3.2 The contractor shall perform the following specific tasks relating to the development of LSP program concepts and approaches. The objectives of this effort are to produce information and data for use by the LSP Project Office in (1) program planning, (2) making technical determinations, (3) providing direction to program personnel, and (4) generating recommendations of actions reserved for higher management authority.
 - 3.2.1 Compile, evaluate, and screen information from IMBLMS files, from Shuttle payloads study reports, and other pertinent sources which relate to the Life Sciences Shuttle Payloads and which may be used to support

the development of Life Sciences Payload Concepts. This data will be evaluated for:

- a. Compatibility with science and application goals and objectives.
- b. Compatibility with basic payload concepts such as simplicity, low cost, maintainability, and reuse.
- c. Compliance with projected state of the art.
- d. Simplicity of accommodation and operational modes (crew time requirements).
- e. Shuttle gravity environments.

3.2.2 Identify, investigate, and analyze information derived from LSP projects and studies, to develop specific information for use in direction and conduct of the LSP program.

3.2.3 In conjunction with the administration of the LSP program activities, the following tasks will be conducted:

- a. Interface with NASA potential principal investigators as directed by the LSP office.
- b. Assist in the delineation and definition of expertise and related activities to be provided by NASA and other organizations; describe the tasks, scheduling requirements, and plans for coordinating results.
- c. Perform studies and analyses of program requirements to provide LSP office with information in areas of technical concern.

3.2.4 Compile, review, and analyze results of LSP studies, equipment development, experiment and P. I. selection, payload planning efforts, test programs, and formulate recommendations for directing on-going activities (Program Management and Control Support).

- 3.3 The contractor shall perform the following tasks related to the preparation of program planning documents and other program support materials useful in administering the LSP program or providing visibility of program activities.
 - 3.3.1 Recommend the overall LSP program documentation requirements (document tree) and provide status and information to assure a timely accomplishment of documentation.
 - 3.3.1.1 Assist LSP office in defining program guidelines and constraints to be observed in the preparation of critical program documentation and materials.
 - 3.3.1.2 Perform reviews of the critical program documentation to insure adequacy and completeness and to identify areas of inadequacy.
 - 3.3.1.3 Coordinate and track the review requirements on LSP program documentation and incorporate approved changes prior to approval and release.
 - 3.3.2 Provide inputs and coordinate the processing of inputs from people involved in the program to consolidate data and prepare draft copies of documents to be used in LSP program management and control.
 - 3.3.3 Provide inputs and coordinate the preparation of supporting materials such as charts, manuals, brochures, procedures, etc., to be used in the implementation of the flight preparation phase of the LSP program.

4.0 Reports

4.1 Progress Reports

The contractor shall submit letter type progress reports at monthly intervals. The progress reports shall include work and funding status, problems encountered, remedial actions, recommendations and conclusions derived from work accomplished.

4.2 Interim Technical Reports

The contractor shall prepare and submit technical reports covering work performed and results of data analyzed when significant phases of major tasks are completed. These shall not exceed four reports during the first 12-month period, and shall include content similar to that stated in paragraph 4.3 below.

4.3 Final Technical Report

The contractor shall prepare and submit the final technical report upon completion of the contract's period of performance. The final technical report shall contain a concise summary of the contractor's efforts during the contract period and include significant data, analysis, results, conclusions, recommendations, and other pertinent information in conjunction with his efforts. A preliminary draft of this report shall be submitted to NASA one month before contract completion, typed double space, in manuscript form, for technical and format review. The contractor shall insure that the report is editorially correct and conforms with accepted practices in scientific technical writing. One week after receipt for review, NASA will return the marked-up draft copy to the contractor for final editing and preparation of the final draft. Within one month after return of the NASA marked-up preliminary draft, the contractor shall furnish NASA the final draft reproducible copy.

EXHIBIT B
STATEMENT OF WORK
LIFE SCIENCES PAYLOADS ANALYSES
AND TECHNICAL PROGRAM PLANNING STUDIES

- 1.0 The contractor shall plan and coordinate preparations for symposia relating to development of Space Processing for Biochemical or Bio-medical Materials. Symposia subject matter would encompass development of materials, techniques, procedures, instruments, tools, facilities, etc., relating to such Space Processing.

The symposia would be designed to encourage the participation of NASA, Government and private research organizations, industrial firms having existing or potential use for such processes, educational institutions, and others who might be involved in the research program or the evaluation and exploitation of the results.

The approach to establishing the first and subsequent symposia will assume that a periodic reconvening of participants will probably evolve. The first meeting (symposium) will be organized as a pilot meeting dedicated to charting the course and formulating an approach and organization for future meetings. Experts in the potentially productive areas of exploration will be invited to participate in the pilot meeting and will be used as a nucleus group to solicit the participation of others in developing flight program objectives and approaches and identifying the potential utilization of Space Processing.

- 1.1 The contractor, in preparation for the first symposium, shall:

- A. Review the current status of programs related to space manufacturing and inflight analysis;
- B. Identify guidelines for selecting and prioritizing techniques and procedures, and how space environment can yield maximum benefits;
- C. Identify and investigate problem areas induced by zero-g; and

D. Specifically identify the problems associated with adapting current laboratory procedures and apparatus for use in space environment. Upon completion, a program for an in-depth symposium will be presented.

1.2 The contractor shall identify and establish communication with selected scientists to solicit their participation in the initial symposium and later serve as the nucleus group to stimulate national (or international) interest and participation in this NASA research area.

2.0 Period of Performance: This effort shall be completed by June 30, 1974.

EXHIBIT C
STATEMENT OF WORK
LIFE SCIENCES PAYLOADS ANALYSES
AND TECHNICAL PROGRAM PLANNING STUDIES

- 1.0 Define simulator functions required to support the definition of Life Sciences Simulation Laboratory Operations. This will require definition of systems requirements (provisions) for flexibility in simulation support functions such as data acquisition, compression, manipulation, and display. System capability and requirements must be defined to facilitate Life Sciences simulations which vary in discipline, timeline, and operational interfaces. Existing software capabilities such as MEDICS will be utilized in the definition of simulation functions.
- 1.1 The contractor shall perform the following tasks relating to the incorporation of IMBLMS equipment items into the Life Sciences Payload Definition and Integration data bank.
 - 1.1.1 Review the IMBLMS Program documentation to identify equipment items which should be added to the Life Sciences Payload Definition and Integration Study data bank.
 - 1.1.2 Extract engineering data on selected IMBLMS equipment and provide an information matrix compatible with the LSP Definition and Integration Study data bank to facilitate the addition of IMBLMS data to this bank.
- 2.0 The contractor shall perform the following tasks related to documentation preparation and maintenance.
 - 2.1 The contractor shall prepare and maintain documentation developed under paragraphs 3.1 through 3.5 above and shall complete files of documentation and program reference materials to be accessible for immediate review by the Technical Monitor.
- 3.0 Period of Performance: This effort shall be completed by June 30, 1974.

Exhibit D

This extension: Exhibit D, should include the following tasks:

- 1.1 The contractor will plan and implement a program to conduct a telecon survey with scientific personnel associated with selected U.S. and foreign manufacturers of biochemicals and biologicals, with academic institutions that incorporate studies and research in biochemicals and biologicals, with chairmen of working groups of professional societies, and with other appropriate scientific contacts, to establish a person-to-person interface between the NASA Space Bioprocessing Program and the scientific community.
- 1.2 The contractor will develop a summary report describing the NASA Space Bioprocessing Program to people identified through the telecons, to serve as a vehicle for initial introduction to the Space Bioprocessing Program, and to describe to the scientific community various means by which they may obtain additional information and become involved in the program. This report will include some graphical illustrations and short, impact, thought provoking summaries of recent space processing experimental results to get the message to busy people in a brief and interesting document. More detailed and expanded information on the experience gained to date on space processing and outlining the types of space processing that NASA might become involved in will be prepared and made available on a more select basis later in the contract period. This activity will be initiated at the earliest time that an intelligent selection of recipients of such materials can be identified.
- 1.3 Based upon results of the telecons and feedback from persons contacted through the telecons or mail distribution, the contractor will suggest participants to NASA for the initial Space Bioprocessing symposium to be conducted in 1975. Selection of participants, guest speakers, and scheduling will be the responsibility of NASA.

- 1.4 The contractor will perform all activities necessary to prepare for the symposium and to plan for the accommodation of the symposium participants: and the contractor will support the preparation of the materials to be used in the conduct of the symposium.
- 1.5 The contractor will allocate certain expenses to process the financing of the paid attendees of the symposium including the arrangement of transportation, lodging, speaker honorariums, etc. The contractor may also, with approval of the NASA monitor, pay selected scientific consultants to evaluate the science merit and practicality of proposed space bioprocessing experiments and development projects. The total amount of such expenses paid to these attendees, guest speakers, or consultants will not exceed \$17K.
- 2.0 Contractor will conduct a study to determine and describe a course of action by which commercially available equipment or systems could be evaluated for possible use in space flight research. The contractor will describe in detail the techniques of selection of an instrument or system from those available commercially, and he will describe a detailed program to analyze the instrument with respect to failure modes, operations and maintenance, redundancy of critical components, integration, installation, documentation, calibration, and other factors influencing the selection or use of this equipment item or system in Spacelab biomedical research. The contractor will also provide a list of instruments and equipment generally applicable to conducting the investigative phase of the experiments program. This equipment would include but not necessarily be limited to: a DC to 100 KHZ cathode-ray oscilloscope, a 4 to 6 channel pen writing oscillograph, a 0 to 100 KHZ signal generator, typical signal conditioners and amplifiers, desk top calculators, a small computer, analog-to-digital converter, and electrophoretic equipment.

Exhibit E

- 1.0 The contractor will conduct studies and provide technical and scientific support in the accomplishment of the planning and implementation of Life Sciences Mission Simulation Test II (LSMS-II), the definition of requirements for the first Life Sciences flight mission experiments payload, and the preparation of documentation summarizing the results of LSMS-I, which will involve the following activities:
 - 1.1 Define the payloads concept development and facility preparation activities scheduled for completion in 1975.
 - 1.2 Based on the activities identified, develop the basic objectives of LSMS-II. These objectives will identify the concepts to be developed or modified, the specific modifications to the Life Sciences Payloads Facility to upgrade the facility to a Class II configuration, and will extend the mission period being simulated by the test to include preflight preparation and preflight and postflight operations.
 - 1.3 Contractor will perform the initial test planning and develop the requirements and outline for the Spacelab Life Sciences Mission Simulation Payload Test II.
 - 1.4 Contractor will support the Payloads Office in the definition of the mission objectives and the selection of experiments for the Life Sciences first flight mission.
 - 1.5 Contractor will review the material prepared by the various directorates of JSC which describes specific areas of test results and edit and reformat this material to achieve uniformity and clarity of style and format, to minimize repetition or omissions, and to attain professional quality graphics and illustrations and will coordinate the reproduction and other activities necessary for the production and release of the document.

EXHIBIT "F"
STATEMENT OF WORK

It is requested that Boeing provide for the performance of tasks described below, as additional effort to contract NAS 9-13655. The period of performance shall be January 1, 1975 through July 31, 1975. This effort should be identified as Exhibit "F" of the Statement of Work, and will include the following tasks:

- 1.1 The contractor shall continually conduct reviews and evaluations of the design, development, and testing of the Shuttle Orbiter Urine Management System. The result of these studies will provide the definition and updating of interface requirements, identification of system deficiencies and problem areas, and recommendation or development of additional test or verification programs as required.
- 1.2 The contractor will perform studies and analyses which will supplement both in-house and contract R&D associated with development of the Shuttle Orbiter Urine Management System.
- 1.3 The contractor will provide technical expertise in the coordination of development of Life Sciences Payloads support systems. Included will be the definition of equipment requirements, establishment of performance parameters, and coordination of development efforts in conjunction with planned mission and experiment activities.
- 1.4 The contractor shall document data and prepare status reports for the aforementioned tasks. Such reports will be made a part of the periodic reports currently required by this contract.

STATEMENT OF WORK

1.0 GENERAL REQUIREMENTS

The contractor shall conduct research and development in preparation for and in support of NASA's Life Sciences Payloads (LSP) Program activities. Included are: (1) tasks involving program definition of requirements, LSP facilities, equipment, and operations; (2) tasks pertinent to the preparation and conduct of the Spacelab Mission Simulations (SMS); (3) tasks relating to the selection and development of payloads or experiments; and (4) tasks involving the preparation of documentation for SMS planning, conduct, and reporting. These tasks will be conducted in conjunction with the Bioscience Payloads Office. Close and continuing coordination with NASA personnel will be maintained to assure that study results are responsive to program needs.

2.0 SPECIFIC REQUIREMENTS

The contractor shall accomplish the following.

- 2.1 In conjunction with the LSP Program Office the contractor shall conduct studies to:
 - 2.1.1 Define requirements for LSP facilities, equipment, and operations software to support the preparation and operations of Life Sciences Payloads Center.
 - 2.1.2 Define logistical resources required and identify significant activities involved in the implementation of a Payloads Operations Center.
- 2.2 In support of the preparation, conduct, and reporting of the SMS II the contractor shall:
 - 2.2.1 Conduct special studies and analyses directed by the LSP Program Office to define requirements for equipment, facilities, and operations required for the accomplishment of SMS II.

2.2.2 Assist in the definition of supporting functions and activities of NASA organizations in the preparation and conduct of SMS II and prepare schedules and status summaries of the activities of each organization.

2.3 Provide the scientific and engineering expertise to:

2.3.1 Interface with acting PI's as directed by the LSP Office to coordinate the development of SMS II experiments.

2.3.2 Interface with project and systems engineers to coordinate, track status, and recommend Payloads Office actions to assure timely development of experiment equipment and Spacelab subsystems.

2.3.3 Prepare planning documentation and reports of testing accomplished in SMS II. This task will include the conduct of studies and coordination with test participants in the development of a recommended format and content for reporting the test results for SMS.

2.3.4 Develop a system for incorporating the SMS results into the ongoing design, development, or operations of the Spacelab, the Life Sciences Payloads, LSP facilities, or LSP equipment.

2.3.5 Develop a preliminary set of objectives and associated requirements for SMS III.

2.3.6 Accomplish special studies and investigations, and compile technical information in support of the definition and development of the first Life Sciences flight payload.

EXHIBIT H
STATEMENT OF WORK

The Life Sciences Directorate is currently preparing for an experimental test program utilizing the Spacelab/Shuttle system. This preparation will include a series of simulated flight missions in which typical Life Sciences experiments will be performed under simulated Spacelab flight conditions. Such simulations will be useful in developing and verifying design and operational concepts, and for defining program requirements. The timely reporting of these simulated missions in a family of comprehensive reports is essential to incorporating test results into on-going design and operational planning and development. The Boeing Company will work in support of NASA to document the results of mission simulations.

In performance of this reporting and documentation effort, Boeing will coordinate the compilation of report materials and will edit, type, and format these materials into a series of reports to be released by NASA. The progress of preparations of these materials will be reviewed periodically with an assigned NASA monitor, to assure accuracy of the material and the quality of the final product.

SPECIFIC TASKS

In the accomplishment of the documentation effort, the Boeing Company will perform the following specific tasks:

- TASK 1 - Upon receipt of the report material, the Boeing Technical Editor will review the material to identify the adequacy of content, format, quality of graphics, etc., and will coordinate with the reporting NASA elements, as required, to obtain any additional subject material.
- TASK 2 - Boeing will edit and retype this material into a consistent format to prepare the materials for final documentation; and, in conjunction with the NASA monitor, will assemble the materials including

the introductions, technical papers, summary comments, discussion notes, etc., to construct the document formats.

TASK 3 - Upon completion of the preparation of the document materials, Boeing will coordinate the reproduction through the NASA reproduction/printing facilities.

TASK 4 - Boeing will edit and retype the material, as required, to serve as input material for the NASA reports of the mission simulations, and, in conjunction with the NASA monitor, will coordinate the reproduction of materials, preparation of document covers, etc., by NASA reproduction facilities to assure completion of acceptable reports.

ATTACHMENT II

EXAMPLES OF SIGNIFICANT CONTRACT SUBMITTALS

EXAMPLES OF SIGNIFICANT CONTRACT SUBMITTALS

1. LSPDF (Life Sciences Payloads Development Facility)
 - A. CVT Life Sciences Payloads Coordination, Trip Report, (Reference HA-60-205).
 - B. Life Sciences Laboratory Development Plan for Block III CVT [Proposed Tri-Center Agreement], (Reference HA-60-208).
 - C. CVT Integration Fixture Utility Specification Sheet (Reference HA-60-215).
 - D. Life Sciences Laboratory Simulator Facility (Reference HA-60-217).
 - E. Trip Report - Coordination Meeting JSC Test III Integration Fixture (Reference HA-60-218).
 - F. Summary of General Requirements of the LSPDF (Reference HA-60-220).
 - G. Facility Space Allotment Review (Reference HA-60-225).
 - H. Updated Summary of the General Requirements for the LSPDF (Reference HA-60-237).
2. Life Sciences Test I (originally CVT Block III)
 - A. Potential Bioscience Demonstration Program - 16 Suggested CVT Protocols (Reference HA-60-203).
 - B. Potential Bioscience Demonstration Program - 26 Proposed Experiments (Reference HA-60-211).
 - C. Selection of Proposed Demonstrations for CVT Block III (Reference HA-60-212).
 - D. CVT Block III [Life Sciences Test I] Demonstration Protocols (Reference HA-60-214).
 - E. Final Draft of Life Sciences Payloads Development Program Test I (Reference HA-60-224).
3. Program Support
 - A. Planning Information for Pallet Experiments (Reference HA-60-200).
 - B. Suggestions for Pallet Experiments (Reference HA-60-201).
 - C. Life Sciences Payloads Planning Charts (Reference HA-60-202).

D. Documentation Reviews:

- (1) Review of Space Shuttle Level II Program Definition and Requirements Document (Reference HA-60-204).
 - (2) Review of Carry-on Laboratory Task A - Draft (Reference HA-60-216).
 - (3) Review of Task C Carry-on Payloads (Reference HA-60-226).
 - (4) Review and Comments on Launch Site Accommodations Handbook (Reference HA-60-227).
 - (5) Review of Spacelab Payloads Requirements - MSFC Document (Reference HA-60-232).
 - (6) Review of Spacelab Programming Requirements Level I Document (Reference HA-60-232).
 - (7) Review of Concept Development and Verification Project Performance and Requirements Document (Reference HA-60-240).
 - (8) Review of STAR and IAA Categories (Reference HA-60-242).
- E. Life Sciences Shuttle Laboratory Interface Requirements and Implementation Responsibilities (Reference HA-60-206).
- F. Life Sciences Payloads Program Presentation - August 28, 1973 (Reference HA-60-209).
- G. Listing of 40 Experiments for 7- and 30-Day Space Shuttle Missions (Reference HA-60-210).
- H. CVT and JSC Simulations Presentation - September 21, 1973 (Reference HA-60-213).

ATTACHMENT III

2-WAY MEMOS TRANSMITTED TO NASA

LISTING OF 2-WAY MEMOS TRANSMITTED TO NASA

<u>Date</u>	<u>Memo No.</u>	<u>Title</u>
7/18/73	HA-60-202	Life Sciences Payloads Planning Charts
7/23/73	HA-60-203	Transmittal of Potential Bioscience Demonstration Program at MSFC
8/6/73	HA-60-204	Review of Space Shuttle Level II Program Definition and Requirements Document
8/15/73	HA-60-205	Trip Report - CVT Life Sciences Payload Coordination at MSFC
8/22/73	HA-60-206	Life Sciences Shuttle Lab Interface Requirements and Implementation Responsibility
8/30/73	HA-60-207	Preliminary Block III CVT Test Plan
8/30/73	HA-60-208	Life Sciences Laboratory Development Plan for Block III CVT
8/30/73	HA-60-209	Life Sciences Payloads Program Presentation 8/28/73
8/31/73	HA-60-210	Transmittal of Experiment Lists (40)
8/31/73	HA-60-211	Transmittal of Experiment Lists (26)
9/11/73	HA-60-212	Selection of Proposed Demonstrations for CVT Block III Scheduled for July, 1974
9/26/73	HA-60-213	CVT and JSC Simulations (Presentation to R.S. Johnston 9/21)
9/26/73	HA-60-214	Transmittal of Demonstration Protocols
10/15/73	HA-60-215	CVT Integration Fixture Utility Spec Sheet
10/19/73	HA-60-216	Transmittal of Review of Task A Material from NAS 8-30288
11/1/73	HA-60-217	Life Sciences Laboratory Simulator Facility
11/20/73	HA-60-218	Trip Report - Coordination Meeting at MSFC, 11/13/73
1/7/74	HA-60-219	Minutes of Meeting of L.S. Payload Committee, 12/19/73
2/6/74	HA-60-220	Procedure for Handling Deceased Animal in Spacelab Simulation
2/12/74	HA-60-220	General Requirements for Life Sciences Laboratory Development Facility
2/6/74	HA-60-221	Procedure for Handling Deceased Animal in Spacelab Simulation
2/12/74	HA-60-222	Review of Test Plan for Life Sciences Payloads Test I
2/20/74	HA-60-223	Life Sciences Shuttle Payloads Program

<u>Date</u>	<u>Memo No.</u>	<u>Title</u>
3/1/74	HA-60-224	Final Draft of Life Sciences Payloads Development Program Test I
3/1/74	HA-60-225	Facility Space Allotment Review
4/2/74	HA-60-226	Draft of Letter to C. B. May, re: Task C Final Report, Contract NAS 8-30288
4/12/74	HA-60-227	Review and Comments on Launch Site Accommodations Handbook for Shuttle Payloads (Draft)
4/19/74	HA-60-228	Submittal of Draft of Memo to B. O. Montgomery, S&E Director, MSFC, re Third Space Processing Symposium
4/19/74	HA-60-229	Submittal of Operational Factors - Payload Operations Crew Functions Workshop (JSC April 16 & 17, 1974)
4/26/74	HA-60-230	Submittal of Memo and Sample Copies of Correspondence for Space Processing Symposium
5/2/74	HA-60-231	Spacelab Payload Requirements, MSFC Document #PD-74-1
5/3/74	HA-60-232	Spacelab Programme Requirements Level I, Document Review
5/6/74	HA-60-233	Draft of Letter of Transmittal of Status of Preparations for Symposium on Biomedical/Biological Processing
5/8/74	HA-60-234	Trip Report - Third Space Processing Symposium - Skylab Results, MSFC, April 30, and May 1
5/13/74	HA-60-235	MOT Action Items
5/28/74	HA-60-236	Transmittal of Notes Taken at Payloads Coordination Panel Meeting of May 23, 1974
5/29/74	HA-60-237	Transmittal of Final Summary of General Requirements of Life Sciences Payloads Development Facility
5/29/74	HA-60-238	Transmittal of IMBLMS Functions & Methods List and IMBLMS Equipment List
5/29/74	HA-60-239	Transmittal of Test Conductor/Facility Engineer Console Comments
5/31/74	HA-60-240	Review of Concept Verification Test Project Performance and Requirements Document
6/6/74	HA-60-241	Assessment of Microwave Hazard
6/6/74	HA-60-242	Review of STAR and IAA Categories

<u>Date</u>	<u>Memo No.</u>	<u>Title</u>
6/11/74	HA-60-243	Headquarters Restrictions on Holding Symposia and Establishing Standing Committees
6/18/74	HA-60-244	Coordination on Intercenter Planning for CVT
7/8/74	HA-60-245	Minutes of Test Operations Team Meeting, July 2, 1974
7/15/74	HA-60-246	" " " " " " , " 9, 1974
7/19/74	HA-60-247	" " " " " " , " 16, 1974
7/29/74	HA-60-248	" " " " " " , " 23, 1974
8/1/74	HA-60-249	Minutes of Steering Committee Meeting, July 30, 1974
8/7/74	HA-60-250	Transmittal of Comments on Review of SOW for Payloads Contract
8/16/74	HA-60-251	Transmittal of Summary Charts on First 20 Missions
8/16/74	HA-60-252	Transmittal of Issues Prepared in Support of STS Operations Study Team Effort
8/19/74	HA-60-253	Transmittal of Minutes of TOT Meeting, August 13, 1974
8/26/74	HA-60-254	" " " " " " , " 20, 1974
9/3/74	HA-60-255	" " " " " " , " 26, 1974
9/10/74	HA-60-256	Transmittal of DTU Measurements
9/12/74	HA-60-257	Transmittal of Minutes of TOT Meeting, Sept. 11, 1974
9/17/74	HA-60-258	Transmittal of Minutes of Steering Committee Meeting, 9/12/74
10/16/74	HA-60-259	Transmittal of Updated Dimension Data on Life Sciences Test I DTU and Spacelab
10/16/74	HA-60-260	Transmittal of First Draft of Life Sciences Test II Preparations and Schedule
10/22/74	HA-60-261	Proceedings of the Skylab Life Sciences Symposium (Vols. I and II)
10/25/74	HA-60-262	Transmittal of Preliminary Requirements for three Test II Alternative Approaches
10/28/74	HA-60-263	Transmittal of Data Re Building 37 Facility Modifications
11/22/74	HA-60-264	Review of Safety Policy and Requirements for Payloads Document

<u>Date</u>	<u>Memo No.</u>	<u>Title</u>
12/2/74	HA-60-265	Response to Dr. Simmonds' Letter of Nov. 14, Requesting a Review of Maintenance Requirements for Biological Specimens in Spacelab
1/13/75	HA-60-267	Maintenance Requirements for Biological Specimens in Spacelab
1/27/75	HA-60-268	Review of "Safety Policy & Requirements for Payloads Using the National Space Transportation System"
1/27/75	HA-60-269	Spacelab Team L PRR RID L-G-72
1/28/75	HA-60-270	Transmittal of Draft Letter, Subject: Skylab Scientific Experiment Pictures
2/14/75	HA-60-271	Transmittal of RID's
2/14/75	HA-60-272	Transmittal of Draft Letter of Suggested Changes to APO
2/24/75	HA-60-273	Status of Planning for Bioprocessing in Space
3/3/75	HA-60-274	Preliminary Analysis of LSP Command/Response Requirements
3/11/75	HA-60-275	RIDS to GSE Documents
3/11/75	HA-60-276	Shuttle Orbiter Mid-deck Carry-on Payloads Accommodations
3/20/75	HA-60-278	Transmittal of Orientation Materials on Scope and Characteristics of Life Sciences Payloads
4/29/75	HA-60-282	Transmittal of Review Draft of Facility Requirements for SMS-II
5/23/75	HA-60-285	SMS-I General Summary Report
6/4/75	HA-60-286	Transmittal of Preliminary Planning Charts for SMS-III
7/2/75	HA-60-288	Telecon Survey - Recalls
7/11/75	HA-60-289	Boeing Activities
8/1/75	HA-60-291	SMS-II Facility Requirements Document Transmittal
10/3/75	HA-60-296	Transmittal of Boeing Review of Headquarters Test Specimen List
10/14/75	HA-60-297	Major Hardware Used to Support SMS-I
10/23/75	HA-60-300	SMS-II Engineering Objectives versus Operational Test Requirements

<u>Date</u>	<u>Memo No.</u>	<u>Title</u>
10/27/75	HA-60-301	Transmittal of Selected University Organizations for Bioprocessing in Space
11/13/75	HA-60-302	Summary of Telecon Survey of Potential Space Bioprocessing Experimenters
12/12/75	HA-60-303	Transmittal of Reporting Plan and Experiments and Operations Requirements Document
12/12/75	HA-60-304	Transmittal of Colloquium Announcement & Work Order
12/15/75	HA-60-305	Transmittal of Reproduction Order for Brochure on Space Bioprocessing
12/15/75	HA-60-306	Technical Review of HSD Specification SVHS 7216
12/17/75	HA-60-307	SMS-II Interface Control Document
12/19/75	HA-60-308	Announcement Mailing List for Colloquium on Bioprocessing in Space
1/15/76	HA-60-309	Baseline SMS-II Inflight Logistics Requirements